

PHOTOELECTRIC OBSERVATIONS AND ORBITAL SOLUTIONS OF BV 267

by

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ABSTRACT

Photoelectric photometry was made in two wavelength regions on a newly discovered eclipsing variable system BV 267. The previously published light elements were found to disagree with the actual light change of the system and new light elements were obtained. Also, light curves and orbital solutions were obtained. Conventionally, BV 267 may be classified as an Algol type variable.

INTRODUCTION

The variable nature of the light of BV 267 (BD +46°0985) was first reported by W. Strohmeier (1959). The first light elements were also reported by W. Strohmeier (1963) to I.A.U. Commission 27. Later in the same year W. Strohmeier, R. Knigge and H. Ott (1963) published a list of photographically determined times of minima and a light curve. Their observations were obtained from sky-patrol plates at Remeis-Sternwarte, Bamberg, Germany.

This observer, however, found that the light elements and the shape of the light curve published did not agree with the actual light change of the system observed photoelectrically. A considerable difficulty was encountered in observing the variable system due to absence of correct light

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elements. This was mainly due to the fact that the period is very close to 1.25 days and an observer could keep observing BV 267 at its rather constant maximum light repeatedly for many nights. By the end of the winter of 1964, however, fairly reliable light elements were obtained, thus making it possible to complete light curves during the following observing season of the fall 1964 to winter 1965.

OBSERVATIONS

The equipment used for this work was the 15-inch siderostat refractor and Pierce-Blitzstein pulse-counting photometer of the Flower and Cook Observatory, University of Pennsylvania. The effective wavelength of the yellow filter was estimated to be 5410 \AA and that of the blue filter 4250 \AA . The photometer diaphragm has a diameter of 0.0070 inch, which is equivalent to 69 seconds of arc. The resolving time of the photometer was found to be 8.5 ± 0.1 p.e. microseconds.

The observations of BV 267 were made in two wavelength regions on 25 nights between October 1963 and March 1964, and between September 1964 and January 1965. A total of 1042 observations in yellow and 1046 observations in blue were obtained, from which 521 observed points in yellow and 523 points in blue were gotten for the light curves through a process of reduction where two such observations were averaged to yield one observed point. The probable errors of the single observation were computed to be $\pm 0^m.006$ in yellow and $\pm 0^m.009$ in blue.

BV 267 is located within half a degree of Alpha Aurigae, and the sky background is affected by the light from Alpha Aurigae (HD 34029), which is visually classified as 0^m.21 and photographically as 0^m.77 in the Henry Draper Catalog. The sky background is non-uniform for the stars in the vicinity.

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It was therefore necessary to account for the difference in sky backgrounds for variable, comparison, and check stars. For this reason the sky background observations were made individually for each star in its immediate vicinity.

The light curves of primary eclipse are not quite symmetric near the shoulders. This system has light curves which may be classified as Algol type, but, as can be seen from both the period and the solution, BV 267 is most likely a fairly close pair. In addition, the primary component is classified as a B9 star. Such an early type star, even as a single star, often has an extended atmosphere. It is then not very unreasonable to assume that there exists circum-stellar matter that causes some perturbations of the light curve of the binary system.

The comparison and check stars are listed in Table 1 together with other pertinent information.

As a check star, BD +46⁰981 was first used, but this star is considerably fainter than the variable and comparison stars. Consequently, BD +46⁰973 was chosen as comparison at a later time and was used until the conclusion of the observations.

Judging from the available observations, the comparison and both check stars appear to have constant light. $m_c - m_{chI} = -0.749$ in yellow and $m_c - m_{chI} = -0.110$ in blue; $m_c - m_{chII} = -0.314$ in yellow and $m_c - m_{chII} = -0.435$ in blue. The probable error of a single observation in yellow was computed to be ± 0.012 , and in blue ± 0.017 for check star I. For check star II, the probable error of a single observation in yellow was computed to be ± 0.011 , and in blue ± 0.010 .

REDUCTIONS

The reductions were carried out using the Deltamag Averaging Program on IBM 7040 computer system. This program averages consecutive variable or check star observations made between a set of comparison star observations. The program

applies linear interpolation for the reduction and computes $\text{deltamag} = m_c - m_v$ or $m_c - m_{ch}$. The sky background is first found by interpolation and is subtracted. The Deltamag Averaging Program was modified for the reduction of BV 267 so that a different background might be subtracted for each star. Appropriate extinction coefficients may be assigned to each star, and the program applies the differential extinction correction. The program also applies the light-time correction and gives the heliocentric Julian Date. The computed magnitude differences are also corrected for resolving time of the Pierce-Blitzstein pulse-counting photometer.

LIGHT ELEMENTS

The first light elements published by W. Strohmeier, R. Knigge, and H. Ott (1963) were as follows:

$$\text{Min} = \text{J.D. } 2426650.570 + 0.^d684315 \text{ E}$$

The photographically observed times of minima and light curve were also published together with the light elements. These light elements, however, proved to be incorrect after photoelectric observation was started.

As discovered later, the period of BV 267 is close to 1.25 days with the same phase repeating itself at approximately the same time of the night on every fifth date. If one happens to be observing the rather flat maxima, which last several hours, on every night he happens to be observing, he may not be able to have any idea about the period of the variable for a long time. In fact, after a fortunate observation of the primary minimum in the very beginning, this observer kept missing another primary minimum for quite a while since the true period was unknown to him. Various possibilities, including twice and thrice the published period, were tried to predict another time of minimum light, with no success. It was the observation of three secondary minima, though quite shallow, that furnished a clue to the correct period. It was noticed on J.D. 2438385 that this

shallow secondary minimum had occurred at approximately the same time of the night at 35 and 5 day intervals. It was then assumed that the period was close to a quantity obtainable by dividing 5 days by some integer. Only approximate estimates may be made by this method, because it was not possible to determine accurately the times of secondary minimum light for such shallow eclipses. The interval of 5 days was divided by integers 1 through 6, since a period shorter than $5/6$ day was not consistent with the observations already available. $5/4$ days = 1.25 days seemed to fit the already available observations.

Another primary minimum covering most of the ingress was observed on J.D. 2438402, as was predicted by the new light elements. On J.D. 2438442 another primary eclipse was observed, this time right at phase 0.0, though most of the egress was missed. It was not until the fall of 1964, however, that really reliable light elements were established. From two best-covered primary minima, one on J.D. 2438327 and another on J.D. 2438700, new correct light elements were derived. The other observations of times of primary minima, on J.D. 2438442 and J.D. 2438680 agreed with the new light elements quite well. Those times of minima were not used for the derivation of light elements since the coverage of the eclipse was not very long; a least squares calculation using all the times of minima was not justified. All the times of secondary minima were also evaluated and found to agree well with phase 0.5. However, since secondary minimum is shallow, this does not furnish us with accurate information regarding the eccentricity and ω of the orbit. Since there was no evidence to the contrary, a circular orbit was assumed for the solution.

Since no consistent relation was found with the photographic times of minima, they could not be incorporated in this period study.

The two times of primary minima used for the derivation of the light elements are:

J.D. 2438327.7867 and J.D. 2438700.7403

The new light elements for BV 267 are:

$$\text{Min} = \text{J.D. } 2438327.7867 + 1.^d2473364 \text{ E}$$

The method used for determining the times of minima was the tracing paper method.

RECTIFICATION

Fourier coefficients used for rectification were obtained assuming the light change of the eclipsing system outside eclipse to be expressed by the following truncated Fourier series:

$$= A_0 + A_1 \cos \theta + A_2 \cos 2\theta + B_1 \sin \theta + B_2 \sin 2\theta.$$

Normal points were used for the rectification. They were computed so that $\Delta m = m_v - m_c = 0$ at the maximum light. Fourier analysis and the rectification were carried out using the Fourier Coefficients Program and the Simplified Rectification Program. The Fourier Coefficients thus computed are given in Table 2.

BV 267 has a negative A_1 as the theory of reflection predicts. Hence, the reflection coefficients used for the rectification were computed by the standard method by H. N. Russell and J. E. Merrill.

SOLUTION

The solution was made using J. E. Merrill's nomographs and tables for the solution of light curves of eclipsing binaries (1950). The notation used is the same as defined by H. N. Russell and J. E. Merrill (1952), unless otherwise stated.

The yellow solution was found using the nomograph for $x = 0.6$, and the blue solution using that for $x = 0.8$. The intersection of the depth-relation line and the shape-relation curve was found to be tangential, indicating that there may be more than one possibility of solution at about $k = 0.65$ to 0.67 .

It was hence decided that various sets of values of k , α_o^{oc} , and α_o^{tr} be tried to find the best solution possible. From the nomographic solution, a solution did not appear possible under the assumption that the primary minimum is an occultation; nevertheless, a theoretical light curve was computed before dismissing this approach entirely.

Several sets of k , α_o^{oc} , and α_o^{tr} were computed from the depth relation and Merrill's tables (1950), and theoretical light curves were calculated for each set. $x = 0.2$, 0.4 , 0.6 and 0.8 were tried before $x = 0.6$ for yellow and $x = 0.8$ for blue were selected as the best values of limb darkening coefficient. The spectral type of the smaller, fainter component was estimated to be F2 to F3.

CONCLUSIONS

Conventionally, BV 267 may be classified as an Algol type eclipsing variable.

In order for us to learn something about the absolute dimension of this eclipsing system, we need a radial velocity curve and orbital elements determined therefrom. However, the light of the secondary component is only about 6% of the total light in blue, where the plates are usually more sensitive, and it is rather unlikely that the secondary spectrum could be observed on a spectrogram. Spectroscopically, BV 267 will probably be a one-spectrum system.

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The information regarding the computer programs may be made available at the University of Pennsylvania to interested readers. Deltamag Averaging Program was developed by Dr. W. Blitzstein and Mrs. P. Brown Savage; Linearized Least Squares Program by Mr. A. J. Harris; and Fourier Coefficients Program and Simplified Rectification Program by Dr. L. Binnendijk and Mr. A. J. Harris.

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Table 1

Variable, Comparison and Check Stars

| <u>Star</u> | <u>B.D. No.</u> | <u>H.D.No.</u> | <u>S.P.Type</u> | <u>R.A.(1964)</u> | <u>Dec.(1964)</u> |
|-------------|-----------------|----------------|-----------------|---|-------------------|
| BV 267 | +46°0985 | 33853 | (B9) | 5 ^h 12 ^m 50 ^s .9 | +46°20'8 |
| Comparison | +45°1076 | | *(F2) | 5 ^h 13 ^m 47 ^s .8 | +46°07'3 |
| Check I | +46°0981 | 33732 | (G5) | 5 ^h 11 ^m 58 ^s .9 | +46°20'2 |
| Check II | +46°0973 | 33381 | (F5) | 5 ^h 09 ^m 34 ^s .5 | +46°26'1 |

The asterisk,* indicates that the spectral type was estimated from the color ($m_b - m_y$) of the star, which was reduced to outside the earth's atmosphere. The color ($m_b - m_y$) of the comparison star in Johnson and Morgan's system is approximately 0.^m48. This star was probably not included in the Henry Draper Catalog because of its nearness to Alpha Aurigae.

Table 2

Fourier Coefficients with p.e.'s for BV 267

| λ | A_0 | A_1 | A_2 | B_1 | B_2 |
|-----------|----------|----------|----------|----------|----------|
| Yellow | +.9704 | -.0211 | -.0281 | +.0003 | +.0027 |
| | \pm 07 | \pm 09 | \pm 12 | \pm 06 | \pm 06 |
| Blue | +.9748 | -.0155 | -.0206 | +.0026 | +.0027 |
| | \pm 10 | \pm 12 | \pm 15 | \pm 07 | \pm 08 |

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Table 3

Quantities for BV 267 Determined from
Photoelectric Orbital Solution

| <u>Geometrical Quantities</u> | | <u>Photometric Quantities</u> | |
|-------------------------------|---------|---------------------------------------|---------------------------------------|
| k | = 0.65 | Yellow | Blue |
| a _g | = 0.39 | x = 0.6 | x = 0.8 |
| b _g | = 0.38 | L _g = 0.923 | L _g = 0.943 |
| a _s | = 0.25 | L _s = 0.077 | L _s = 0.057 |
| b _s | = 0.24 | α_o^{oc} = 0.85 | α_o^{oc} = 0.86 |
| j | = 77.0 | α_o^{tr} = 0.78 | α_o^{tr} = 0.77 |
| θ_e | = 38.0 | $1 - \frac{oc}{o} = 0.065$ | $1 - \frac{oc}{o} = 0.051$ |
| p _o | = -0.63 | $1 - \frac{tr}{o} = 0.334$ | $1 - \frac{tr}{o} = 0.352$ |
| ϵ | = 0.02 | J _h /J _c = 5.12 | J _h /J _c = 6.94 |

$J_h/J_c = J_g/J_s$, and the smaller, cooler star is in front at the time of primary minimum, i.e., the primary minimum is a transit eclipse.

Table 4a Observations of BV 267, Yellow

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 327.70473 | 0.93428 | -0.075 | 345.86568 | 0.49406 | -0.014 |
| .71373 | 0.94149 | -0.140 | .87038 | 0.49783 | -0.021 |
| .72153 | 0.94775 | -0.186 | .87878 | 0.50457 | -0.017 |
| .73233 | 0.95641 | -0.241 | .88478 | 0.50938 | -0.032 |
| .73833 | 0.96122 | -0.281 | .89138 | 0.51467 | -0.018 |
| .74673 | 0.96795 | -0.322 | .90098 | 0.52236 | -0.008 |
| .75273 | 0.97276 | -0.337 | .90728 | 0.52742 | -0.006 |
| .76023 | 0.97877 | -0.397 | .91418 | 0.53295 | +0.003 |
| .77043 | 0.98695 | -0.440 | .92018 | 0.53776 | -0.006 |
| .77733 | 0.99248 | -0.456 | .92858 | 0.54449 | +0.016 |
| .78393 | 0.99777 | -0.470 | .93518 | 0.54978 | +0.010 |
| .79053 | 0.00307 | -0.462 | 349.66202 | 0.53762 | -0.010 |
| .79953 | 0.01028 | -0.433 | .66862 | 0.54291 | -0.012 |
| .80733 | 0.01653 | -0.419 | .67762 | 0.55013 | +0.012 |
| .81573 | 0.02327 | -0.382 | .68362 | 0.55494 | +0.032 |
| .82233 | 0.02856 | -0.349 | .69322 | 0.56263 | +0.030 |
| .83073 | 0.03529 | -0.300 | .69982 | 0.56793 | +0.039 |
| .83793 | 0.04107 | -0.263 | .70972 | 0.57586 | +0.062 |
| .84453 | 0.04636 | -0.217 | .71542 | 0.58043 | +0.043 |
| .85053 | 0.05117 | -0.199 | .72682 | 0.58957 | +0.048 |
| .85953 | 0.05838 | -0.132 | 358.71405 | 0.79471 | +0.062 |
| .86553 | 0.06319 | -0.116 | .72365 | 0.80241 | +0.063 |
| .87153 | 0.06800 | -0.094 | .73055 | 0.80794 | +0.076 |
| .87753 | 0.07281 | -0.079 | .80475 | 0.86742 | +0.027 |
| .88773 | 0.08099 | -0.044 | .82515 | 0.88378 | +0.031 |
| .89373 | 0.08580 | -0.017 | .83115 | 0.88859 | +0.033 |
| .89973 | 0.09061 | -0.002 | .83955 | 0.89532 | +0.029 |
| .90633 | 0.09590 | 0.000 | .84555 | 0.90013 | +0.020 |
| 345.77858 | 0.42424 | +0.053 | .85335 | 0.90639 | +0.004 |
| .78998 | 0.43337 | +0.038 | .85995 | 0.91168 | -0.014 |
| .79838 | 0.44011 | +0.030 | .86895 | 0.91889 | -0.040 |
| .80438 | 0.44492 | +0.027 | .87495 | 0.92370 | -0.056 |
| .81398 | 0.45262 | +0.025 | .88095 | 0.92851 | -0.073 |
| .81998 | 0.45743 | +0.008 | .88755 | 0.93381 | -0.087 |
| .82688 | 0.46296 | 0.000 | .89415 | 0.93910 | -0.129 |
| .83618 | 0.47041 | -0.004 | .90075 | 0.94439 | -0.168 |
| .84218 | 0.47522 | -0.010 | .90675 | 0.94920 | -0.185 |
| .85118 | 0.48244 | -0.006 | .91515 | 0.95593 | -0.222 |
| .85718 | 0.48725 | -0.025 | .92115 | 0.96074 | -0.265 |

Table 4a Continued

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 358.92715 | 0.96555 | -0.307 | 380.86719 | 0.55507 | +0.020 |
| .93315 | 0.97036 | -0.330 | .87319 | 0.55988 | +0.028 |
| .93915 | 0.97517 | -0.345 | 385.50939 | 0.27676 | +0.097 |
| .94515 | 0.97998 | -0.384 | .51959 | 0.28493 | +0.108 |
| 380.54239 | 0.29467 | +0.073 | .52679 | 0.29071 | +0.086 |
| .55019 | 0.30093 | +0.096 | .53639 | 0.29840 | +0.099 |
| .56159 | 0.31006 | +0.081 | .54419 | 0.30466 | +0.100 |
| .56759 | 0.31487 | +0.073 | .55499 | 0.31332 | +0.098 |
| .57659 | 0.32209 | +0.082 | .56579 | 0.32197 | +0.082 |
| .58319 | 0.32738 | +0.085 | .57179 | 0.32678 | +0.083 |
| .59339 | 0.33556 | +0.063 | .58079 | 0.33400 | +0.090 |
| .59999 | 0.34085 | +0.080 | .58799 | 0.33977 | +0.082 |
| .60839 | 0.34758 | +0.093 | .59639 | 0.34651 | +0.068 |
| .61499 | 0.35288 | +0.076 | .60239 | 0.35132 | +0.074 |
| .62099 | 0.35769 | +0.076 | .65639 | 0.39461 | +0.077 |
| .63629 | 0.36995 | +0.058 | .66539 | 0.40182 | +0.069 |
| .68899 | 0.41220 | +0.058 | .67139 | 0.40663 | +0.077 |
| .70099 | 0.42182 | +0.047 | .68099 | 0.41433 | +0.066 |
| .71299 | 0.43144 | +0.041 | .68999 | 0.42155 | +0.066 |
| .71899 | 0.43625 | +0.028 | .69839 | 0.42828 | +0.040 |
| .72739 | 0.44299 | +0.035 | .70439 | 0.43309 | +0.042 |
| .73339 | 0.44780 | +0.025 | .71279 | 0.43982 | +0.022 |
| .74179 | 0.45453 | -0.007 | .71939 | 0.44512 | +0.009 |
| .74839 | 0.45982 | +0.008 | .72599 | 0.45041 | +0.009 |
| .75679 | 0.46656 | +0.025 | .73439 | 0.45714 | -0.003 |
| .76279 | 0.47137 | +0.018 | .74039 | 0.46195 | -0.003 |
| .77119 | 0.47810 | -0.012 | .74639 | 0.46676 | +0.007 |
| .77809 | 0.48363 | -0.004 | .75239 | 0.47157 | -0.011 |
| .78679 | 0.49061 | -0.024 | .76259 | 0.47975 | -0.012 |
| .79339 | 0.49590 | -0.012 | .76859 | 0.48456 | -0.011 |
| .80239 | 0.50312 | -0.027 | .77699 | 0.49129 | -0.017 |
| .80839 | 0.50793 | -0.017 | .78299 | 0.49610 | -0.025 |
| .81439 | 0.51274 | -0.024 | .78959 | 0.50140 | -0.028 |
| .82339 | 0.51995 | -0.018 | .79919 | 0.50909 | -0.028 |
| .82999 | 0.52524 | -0.006 | .80519 | 0.51390 | -0.003 |
| .83899 | 0.53246 | -0.005 | .81239 | 0.51967 | -0.016 |
| .84499 | 0.53727 | -0.004 | .81839 | 0.52449 | -0.009 |
| .85519 | 0.54545 | +0.003 | .82859 | 0.53266 | -0.008 |
| .86119 | 0.55026 | +0.014 | .83699 | 0.53940 | -0.006 |

Table 4a Continued

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 385.84359 | 0.54469 | +0.012 | 442.55494 | 0.01065 | -0.455 |
| .85199 | 0.55142 | +0.022 | .56154 | 0.01594 | -0.400 |
| 402.53026 | 0.92253 | -0.049 | .56874 | 0.02171 | -0.376 |
| .54106 | 0.93114 | -0.115 | .57714 | 0.02845 | -0.321 |
| .54706 | 0.93600 | -0.130 | .58494 | 0.03470 | -0.279 |
| .55516 | 0.94249 | -0.142 | .59094 | 0.03951 | -0.253 |
| .56176 | 0.94778 | -0.208 | .59964 | 0.04649 | -0.190 |
| .56836 | 0.95308 | -0.210 | .60594 | 0.05154 | -0.153 |
| .57826 | 0.96101 | -0.257 | .61434 | 0.05827 | -0.114 |
| .58486 | 0.96630 | -0.306 | .62094 | 0.06356 | -0.081 |
| .59326 | 0.97304 | -0.354 | .63354 | 0.07366 | -0.030 |
| .59986 | 0.97833 | -0.404 | .64254 | 0.08088 | -0.001 |
| 429.52072 | 0.56101 | +0.035 | .64854 | 0.08569 | +0.025 |
| .53932 | 0.57592 | +0.059 | .65874 | 0.09387 | +0.021 |
| .54772 | 0.58265 | +0.059 | .66474 | 0.09868 | +0.041 |
| .55612 | 0.58939 | +0.069 | .67314 | 0.10541 | +0.046 |
| .56992 | 0.60045 | +0.082 | .67914 | 0.11022 | +0.050 |
| .57832 | 0.60719 | +0.080 | .68814 | 0.11744 | +0.038 |
| .59032 | 0.61681 | +0.087 | .69414 | 0.12225 | +0.048 |
| .59932 | 0.62402 | +0.079 | .70254 | 0.12898 | +0.059 |
| .61252 | 0.63460 | +0.078 | .70854 | 0.13379 | +0.051 |
| .62152 | 0.64182 | +0.079 | 461.51441 | 0.21062 | +0.073 |
| .62992 | 0.64855 | +0.094 | .52461 | 0.21879 | +0.086 |
| .64252 | 0.65866 | +0.074 | .53301 | 0.22553 | +0.092 |
| .65092 | 0.66539 | +0.097 | .54321 | 0.23371 | +0.091 |
| .65932 | 0.67212 | +0.081 | .55161 | 0.24044 | +0.083 |
| .66772 | 0.67886 | +0.072 | .56061 | 0.24765 | +0.077 |
| .67612 | 0.68559 | +0.072 | .56901 | 0.25439 | +0.096 |
| .68932 | 0.69618 | +0.099 | .57741 | 0.26112 | +0.100 |
| .69772 | 0.70291 | +0.097 | .58581 | 0.26786 | +0.088 |
| .70612 | 0.70964 | +0.094 | .59481 | 0.27507 | +0.089 |
| .71512 | 0.71686 | +0.091 | .60321 | 0.28181 | +0.086 |
| .72352 | 0.72359 | +0.084 | .61161 | 0.28854 | +0.099 |
| .73192 | 0.73033 | +0.085 | .62541 | 0.29961 | +0.091 |
| 442.51474 | 0.97842 | -0.389 | .63561 | 0.30778 | +0.109 |
| .52674 | 0.98804 | -0.434 | .64311 | 0.31380 | +0.095 |
| .53334 | 0.99333 | -0.444 | 471.52524 | 0.23638 | +0.093 |
| .54054 | 0.99911 | -0.473 | .53544 | 0.24456 | +0.110 |
| .54834 | 0.00536 | -0.443 | .54834 | 0.25490 | +0.091 |

Table 4a

Continued

| JD Hel. 2438000± | Phase | $\Delta m(c-v)$ | JD Hel. 2438000± | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 471.56784 | 0.27053 | +0.085 | 679.85640 | 0.25721 | +0.088 |
| .58044 | 0.28064 | +0.079 | .86240 | 0.26202 | +0.074 |
| .58644 | 0.28545 | +0.083 | .86840 | 0.26683 | +0.095 |
| .59724 | 0.29410 | +0.078 | .87560 | 0.27260 | +0.093 |
| .61044 | 0.30469 | +0.096 | .88160 | 0.27741 | +0.092 |
| .62004 | 0.31238 | +0.090 | .89000 | 0.28415 | +0.087 |
| 653.82563 | 0.38813 | +0.074 | .89600 | 0.28896 | +0.105 |
| .83163 | 0.39294 | +0.065 | 680.75512 | 0.97772 | -0.411 |
| .83763 | 0.39775 | +0.061 | .76352 | 0.98446 | -0.436 |
| .84903 | 0.40689 | +0.064 | .77192 | 0.99119 | -0.462 |
| .85683 | 0.41314 | +0.082 | .77792 | 0.99600 | -0.461 |
| .86283 | 0.41795 | +0.067 | .78392 | 0.00081 | -0.466 |
| 676.76473 | 0.77859 | +0.083 | .78992 | 0.00562 | -0.470 |
| .77253 | 0.78485 | +0.084 | .79592 | 0.01043 | -0.451 |
| .80133 | 0.80794 | +0.068 | .80552 | 0.01813 | -0.398 |
| .80853 | 0.81371 | +0.088 | .81212 | 0.02342 | -0.369 |
| .81453 | 0.81852 | +0.085 | .81872 | 0.02871 | -0.333 |
| .83313 | 0.83343 | +0.042 | .82712 | 0.03545 | -0.315 |
| .84453 | 0.84257 | +0.028 | .83312 | 0.04026 | -0.264 |
| 679.71300 | 0.14225 | +0.040 | .84182 | 0.04723 | -0.190 |
| .71900 | 0.14706 | +0.061 | .84872 | 0.05276 | -0.172 |
| .72740 | 0.15379 | +0.054 | .85472 | 0.05757 | -0.144 |
| .73340 | 0.15860 | +0.050 | .86492 | 0.06575 | -0.085 |
| .73940 | 0.16341 | +0.074 | 700.68827 | 0.95830 | -0.234 |
| .75260 | 0.17399 | +0.075 | .69667 | 0.96503 | -0.294 |
| .75920 | 0.17929 | +0.083 | .70267 | 0.96984 | -0.329 |
| .76520 | 0.18410 | +0.065 | .71107 | 0.97657 | -0.365 |
| .77360 | 0.19083 | +0.095 | .71707 | 0.98138 | -0.394 |
| .77960 | 0.19564 | +0.077 | .72307 | 0.98619 | -0.427 |
| .78620 | 0.20093 | +0.064 | .72877 | 0.99076 | -0.457 |
| .79460 | 0.20767 | +0.071 | .73507 | 0.99582 | -0.461 |
| .80060 | 0.21248 | +0.060 | .74107 | 0.00063 | -0.465 |
| .80690 | 0.21753 | +0.090 | .74647 | 0.00495 | -0.449 |
| .81560 | 0.22450 | +0.079 | .75247 | 0.00976 | -0.438 |
| .82220 | 0.22979 | +0.066 | .76087 | 0.01650 | -0.408 |
| .82820 | 0.23460 | +0.077 | .76987 | 0.02371 | -0.369 |
| .83420 | 0.23941 | +0.085 | .77647 | 0.02901 | -0.332 |
| .84140 | 0.24519 | +0.095 | .78247 | 0.03382 | -0.285 |
| .84980 | 0.25192 | +0.100 | .78847 | 0.03863 | -0.269 |

Table 4a Continued

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 700.79687 | 0.04536 | -0.216 | 701.82738 | 0.87153 | +0.044 |
| .80347 | 0.05065 | -0.181 | .83458 | 0.87730 | +0.037 |
| .81007 | 0.05594 | -0.116 | .84058 | 0.88211 | +0.032 |
| .81607 | 0.06075 | -0.102 | .84958 | 0.88933 | +0.051 |
| .82207 | 0.06556 | -0.091 | .85558 | 0.89414 | +0.024 |
| .82867 | 0.07086 | -0.025 | .86158 | 0.89895 | +0.025 |
| .83827 | 0.07855 | -0.005 | .86758 | 0.90376 | +0.028 |
| .84427 | 0.08336 | +0.006 | .87418 | 0.90905 | +0.009 |
| .85087 | 0.08865 | +0.011 | .88018 | 0.91386 | -0.005 |
| .85687 | 0.09346 | +0.032 | .88858 | 0.92059 | -0.022 |
| .86287 | 0.09827 | +0.045 | .89458 | 0.92540 | -0.046 |
| .87487 | 0.10789 | +0.025 | .90058 | 0.93021 | -0.063 |
| .88147 | 0.11319 | +0.036 | .90658 | 0.93502 | -0.089 |
| .88747 | 0.11800 | +0.024 | .91318 | 0.94032 | -0.101 |
| .89527 | 0.12425 | +0.038 | .92098 | 0.94657 | -0.157 |
| .90067 | 0.12858 | +0.048 | 703.67873 | 0.35577 | +0.079 |
| .90667 | 0.13339 | +0.069 | .68473 | 0.36058 | +0.078 |
| .91567 | 0.14060 | +0.050 | .69373 | 0.36780 | +0.075 |
| .92167 | 0.14541 | +0.045 | .70033 | 0.37309 | +0.076 |
| 701.67438 | 0.74887 | +0.107 | .70993 | 0.38079 | +0.075 |
| .68278 | 0.75560 | +0.100 | .71593 | 0.38560 | +0.067 |
| .68878 | 0.76041 | +0.096 | .72223 | 0.39065 | +0.070 |
| .69538 | 0.76570 | +0.080 | .73753 | 0.40291 | +0.072 |
| .70558 | 0.77388 | +0.084 | .74353 | 0.40772 | +0.059 |
| .71758 | 0.78350 | +0.089 | .75223 | 0.41470 | +0.048 |
| .72358 | 0.78831 | +0.087 | .75493 | 0.41686 | +0.060 |
| .72958 | 0.79312 | +0.079 | .76063 | 0.42143 | +0.054 |
| .73558 | 0.79793 | +0.087 | .76993 | 0.42889 | +0.068 |
| .74878 | 0.80851 | +0.100 | .77593 | 0.43370 | +0.064 |
| .75478 | 0.81333 | +0.070 | .78403 | 0.44019 | +0.031 |
| .76078 | 0.81814 | +0.083 | .79093 | 0.44572 | +0.038 |
| .76678 | 0.82295 | +0.063 | .80053 | 0.45342 | -0.007 |
| .77388 | 0.82864 | +0.071 | .80653 | 0.45823 | -0.014 |
| .78178 | 0.83497 | +0.056 | .81373 | 0.46400 | -0.016 |
| .79018 | 0.84171 | +0.055 | .82093 | 0.46977 | -0.015 |
| .79738 | 0.84748 | +0.051 | .82303 | 0.47146 | +0.009 |
| .80338 | 0.85229 | +0.047 | .82963 | 0.47675 | -0.022 |
| .81418 | 0.86095 | +0.053 | .83713 | 0.48276 | -0.007 |
| .82138 | 0.86672 | +0.057 | .84433 | 0.48853 | -0.031 |

Table 4a Continued

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 703.85033 | 0.49335 | -0.022 | 707.91131 | 0.74907 | +0.080 |
| .85693 | 0.49864 | -0.015 | 714.62760 | 0.13357 | +0.044 |
| .86533 | 0.50537 | -0.016 | .63600 | 0.14031 | +0.049 |
| .87373 | 0.51211 | -0.011 | .64500 | 0.14752 | +0.079 |
| .87973 | 0.51692 | -0.010 | .65340 | 0.15426 | +0.078 |
| .88753 | 0.52317 | -0.004 | .66180 | 0.16099 | +0.072 |
| .90253 | 0.53519 | +0.002 | .67020 | 0.16773 | +0.067 |
| .91273 | 0.54337 | +0.003 | .67860 | 0.17446 | +0.062 |
| 707.66471 | 0.55137 | +0.033 | .68820 | 0.18216 | +0.079 |
| .67131 | 0.55666 | +0.034 | .69780 | 0.18985 | +0.082 |
| .67731 | 0.56147 | +0.039 | .70620 | 0.19659 | +0.091 |
| .68571 | 0.56820 | +0.048 | .71670 | 0.20500 | +0.108 |
| .69231 | 0.57349 | +0.071 | 730.76263 | 0.06916 | -0.055 |
| .69831 | 0.57830 | +0.049 | .76863 | 0.07397 | -0.027 |
| .70611 | 0.58456 | +0.089 | .77523 | 0.07926 | -0.011 |
| .71241 | 0.58961 | +0.067 | .78423 | 0.08648 | +0.011 |
| .71871 | 0.59466 | +0.093 | .79023 | 0.09129 | +0.025 |
| .72771 | 0.60187 | +0.075 | .79623 | 0.09610 | +0.033 |
| .73371 | 0.60668 | +0.064 | .80283 | 0.10139 | +0.029 |
| .74931 | 0.61919 | +0.068 | .80883 | 0.10620 | +0.031 |
| .75561 | 0.62424 | +0.075 | .82155 | 0.11640 | +0.024 |
| .76301 | 0.63017 | +0.075 | .82893 | 0.12231 | +0.030 |
| .77811 | 0.64228 | +0.088 | .83703 | 0.12881 | +0.049 |
| .78411 | 0.64709 | +0.088 | .84423 | 0.13458 | +0.057 |
| .79161 | 0.65310 | +0.081 | 731.58796 | 0.73083 | +0.086 |
| .79671 | 0.65719 | +0.072 | .59396 | 0.73564 | +0.105 |
| .80571 | 0.66441 | +0.080 | .60296 | 0.74286 | +0.085 |
| .81231 | 0.66970 | +0.084 | .61076 | 0.74911 | +0.111 |
| .81831 | 0.67451 | +0.076 | .62216 | 0.75825 | +0.097 |
| .82431 | 0.67932 | +0.094 | .62966 | 0.76427 | +0.072 |
| .83211 | 0.68557 | +0.092 | .63596 | 0.76932 | +0.073 |
| .83811 | 0.69038 | +0.076 | .64436 | 0.77605 | +0.095 |
| .85131 | 0.70096 | +0.084 | .65036 | 0.78086 | +0.077 |
| .86361 | 0.71083 | +0.093 | .65636 | 0.78567 | +0.084 |
| .86991 | 0.71588 | +0.073 | .66896 | 0.79577 | +0.084 |
| .87591 | 0.72069 | +0.084 | .67886 | 0.80371 | +0.101 |
| .89091 | 0.73271 | +0.081 | .68456 | 0.80828 | +0.089 |
| .89691 | 0.73752 | +0.075 | .69296 | 0.81501 | +0.077 |
| .90291 | 0.74233 | +0.091 | .70556 | 0.82512 | +0.080 |

Table 4a Continued

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 731.71156 | 0.82993 | +0.061 | 761.78988 | 0.94397 | -0.165 |
| .71996 | 0.83666 | +0.052 | .79858 | 0.95094 | -0.226 |
| .72626 | 0.84171 | +0.039 | .80488 | 0.95599 | -0.250 |
| .73256 | 0.84676 | +0.037 | .81088 | 0.96080 | -0.294 |
| .73856 | 0.85157 | +0.048 | .81688 | 0.96561 | -0.317 |
| .74636 | 0.85783 | +0.039 | .82348 | 0.97090 | -0.352 |
| 736.71452 | 0.84084 | +0.054 | .82948 | 0.97571 | -0.383 |
| .72052 | 0.84565 | +0.059 | 767.48056 | 0.50623 | -0.014 |
| .73372 | 0.85623 | +0.060 | .48956 | 0.51345 | -0.001 |
| .73972 | 0.86104 | +0.050 | .50576 | 0.52643 | +0.002 |
| .74572 | 0.86585 | +0.046 | .51416 | 0.53317 | +0.013 |
| .75172 | 0.87066 | +0.029 | .52076 | 0.53846 | +0.008 |
| .77122 | 0.88630 | +0.041 | .52916 | 0.54519 | +0.024 |
| 761.68308 | 0.85834 | +0.047 | .53516 | 0.55000 | +0.031 |
| .68908 | 0.86315 | +0.031 | .54416 | 0.55722 | +0.039 |
| .69508 | 0.86796 | +0.035 | .55016 | 0.56203 | +0.056 |
| .70858 | 0.87879 | +0.027 | .55856 | 0.56876 | +0.055 |
| .71608 | 0.88480 | +0.026 | .56456 | 0.57357 | +0.050 |
| .72808 | 0.89442 | +0.018 | .57296 | 0.58031 | +0.070 |
| .73468 | 0.89971 | +0.020 | .57956 | 0.58560 | +0.086 |
| .74308 | 0.90645 | -0.003 | .58556 | 0.59041 | +0.081 |
| .74968 | 0.91174 | -0.014 | .59816 | 0.60051 | +0.075 |
| .75568 | 0.91655 | -0.040 | .60416 | 0.60532 | +0.075 |
| .76168 | 0.92136 | -0.062 | .61016 | 0.61013 | +0.074 |
| .77008 | 0.92809 | -0.064 | .61916 | 0.61735 | +0.068 |
| .77668 | 0.93338 | -0.102 | .62576 | 0.62264 | +0.083 |
| .78358 | 0.93892 | -0.134 | | | |

Table 4b Observations of BV 267, Blue

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 327.69753 | 0.92851 | +0.296 | 345.86468 | 0.49326 | +0.364 |
| .70653 | 0.93572 | +0.264 | .87158 | 0.49879 | +0.358 |
| .71253 | 0.94053 | +0.258 | .87758 | 0.50360 | +0.369 |
| .72303 | 0.94895 | +0.193 | .88358 | 0.50841 | +0.363 |
| .73113 | 0.95544 | +0.160 | .89288 | 0.51587 | +0.346 |
| .73953 | 0.96218 | +0.085 | .89978 | 0.52140 | +0.365 |
| .74553 | 0.96699 | +0.061 | .90578 | 0.52621 | +0.352 |
| .75393 | 0.97372 | +0.009 | .91538 | 0.53391 | +0.355 |
| .76143 | 0.97974 | -0.034 | .92138 | 0.53872 | +0.362 |
| .76893 | 0.98575 | -0.090 | .92738 | 0.54353 | +0.386 |
| .77613 | 0.99152 | -0.117 | .93638 | 0.55074 | +0.371 |
| .78573 | 0.99922 | -0.116 | 349.65242 | 0.52993 | +0.361 |
| .79203 | 0.00427 | -0.110 | .66082 | 0.53666 | +0.357 |
| .79833 | 0.00932 | -0.097 | .67012 | 0.54412 | +0.374 |
| .80613 | 0.01557 | -0.060 | .67642 | 0.54917 | +0.399 |
| .81693 | 0.02423 | +0.005 | .68482 | 0.55590 | +0.395 |
| .82353 | 0.02952 | +0.029 | .69202 | 0.56167 | +0.410 |
| .82953 | 0.03433 | +0.059 | .70162 | 0.56937 | +0.397 |
| .83673 | 0.04010 | +0.086 | .70822 | 0.57466 | +0.406 |
| .84573 | 0.04732 | +0.165 | .71722 | 0.58188 | +0.407 |
| .85173 | 0.05213 | +0.188 | .72432 | 0.58757 | +0.415 |
| .85833 | 0.05742 | +0.235 | 358.71525 | 0.79567 | +0.440 |
| .86433 | 0.06223 | +0.274 | .72245 | 0.80144 | +0.407 |
| .87273 | 0.06897 | +0.313 | .73265 | 0.80962 | +0.428 |
| .87873 | 0.07378 | +0.319 | .79995 | 0.86358 | +0.384 |
| .88653 | 0.08003 | +0.351 | .80595 | 0.86839 | +0.389 |
| .89493 | 0.08676 | +0.360 | .81195 | 0.87320 | +0.380 |
| .90753 | 0.09687 | +0.388 | .82635 | 0.88474 | +0.373 |
| 345.77978 | 0.42520 | +0.414 | .83235 | 0.88955 | +0.388 |
| .79118 | 0.43434 | +0.411 | .83835 | 0.89436 | +0.372 |
| .79718 | 0.43915 | +0.403 | .84435 | 0.89917 | +0.385 |
| .80588 | 0.44612 | +0.391 | .85455 | 0.90735 | +0.360 |
| .81278 | 0.45165 | +0.383 | .86145 | 0.91288 | +0.351 |
| .82118 | 0.45839 | +0.378 | .86775 | 0.91793 | +0.346 |
| .82868 | 0.46440 | +0.371 | .87375 | 0.92274 | +0.320 |
| .83498 | 0.46945 | +0.363 | .87975 | 0.92755 | +0.294 |
| .84098 | 0.47426 | +0.367 | .88635 | 0.93284 | +0.258 |
| .84998 | 0.48148 | +0.367 | .89535 | 0.94006 | +0.223 |
| .85598 | 0.48629 | +0.353 | .90195 | 0.94535 | +0.199 |

Table 4b / Continued

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 358.90795 | 0.95016 | +0.189 | 380.85399 | 0.54448 | +0.37275 |
| .91395 | 0.95497 | +0.146 | .86239 | 0.55122 | +0.375 |
| .91995 | 0.95978 | +0.097 | .86839 | 0.55603 | +0.374 |
| .92595 | 0.96459 | +0.063 | 385.51059 | 0.27772 | +0.476 |
| .93195 | 0.96940 | +0.041 | .51779 | 0.28349 | +0.465 |
| .93795 | 0.97421 | -0.005 | .52799 | 0.29167 | +0.465 |
| .94605 | 0.98071 | -0.069 | .53519 | 0.29744 | +0.467 |
| 380.54119 | 0.29371 | +0.425 | .54599 | 0.30610 | +0.456 |
| .55139 | 0.30189 | +0.433 | .55619 | 0.31428 | +0.453 |
| .55979 | 0.30862 | +0.424 | .56459 | 0.32101 | +0.453 |
| .56879 | 0.31584 | +0.422 | .57299 | 0.32775 | +0.448 |
| .57479 | 0.32065 | +0.412 | .57899 | 0.33256 | +0.439 |
| .58439 | 0.32834 | +0.430 | .58919 | 0.34073 | +0.432 |
| .59219 | 0.33460 | +0.430 | .59519 | 0.34554 | +0.435 |
| .60119 | 0.34181 | +0.446 | .60359 | 0.35228 | +0.436 |
| .60719 | 0.34662 | +0.442 | .65759 | 0.39557 | +0.432 |
| .61619 | 0.35384 | +0.420 | .66419 | 0.40086 | +0.423 |
| .63779 | 0.37115 | +0.421 | .67259 | 0.40760 | +0.414 |
| .69019 | 0.41316 | +0.426 | .67979 | 0.41337 | +0.422 |
| .69619 | 0.41797 | +0.445 | .69119 | 0.42251 | +0.416 |
| .70579 | 0.42567 | +0.408 | .69719 | 0.42732 | +0.408 |
| .71179 | 0.43048 | +0.429 | .70559 | 0.43405 | +0.404 |
| .72019 | 0.43722 | +0.393 | .71159 | 0.43886 | +0.401 |
| .72619 | 0.44203 | +0.400 | .72059 | 0.44608 | +0.396 |
| .73459 | 0.44876 | +0.397 | .72719 | 0.45137 | +0.365 |
| .74059 | 0.45357 | +0.372 | .73319 | 0.45618 | +0.369 |
| .74959 | 0.46079 | +0.377 | .73919 | 0.46099 | +0.374 |
| .75549 | 0.46552 | +0.354 | .74759 | 0.46772 | +0.372 |
| .76999 | 0.47714 | +0.355 | .75359 | 0.47253 | +0.358 |
| .77959 | 0.48484 | +0.357 | .76379 | 0.48071 | +0.352 |
| .78559 | 0.48965 | +0.356 | .76979 | 0.48552 | +0.347 |
| .79519 | 0.49734 | +0.360 | .77579 | 0.49033 | +0.357 |
| .80119 | 0.50215 | +0.360 | .78479 | 0.49755 | +0.345 |
| .80719 | 0.50696 | +0.356 | .79079 | 0.50236 | +0.347 |
| .81589 | 0.51394 | +0.352 | .80399 | 0.51294 | +0.360 |
| .82219 | 0.51899 | +0.370 | .81359 | 0.52064 | +0.352 |
| .83119 | 0.52621 | +0.378 | .81959 | 0.52545 | +0.343 |
| .83779 | 0.53150 | +0.372 | .82739 | 0.53170 | +0.364 |
| .84379 | 0.53631 | +0.370 | .83819 | 0.54036 | +0.357 |

Table 4b Continued

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 385.84479 | 0.54565 | +0.384 | 442.56274 | 0.01690 | -0.057 |
| .85079 | 0.55046 | +0.389 | .56994 | 0.02268 | -0.018 |
| 402.53206 | 0.92397 | +0.293 | .57834 | 0.02941 | +0.025 |
| .53986 | 0.93023 | +0.254 | .58374 | 0.03374 | +0.069 |
| .54826 | 0.93696 | +0.249 | .59214 | 0.04047 | +0.099 |
| .55426 | 0.94177 | +0.222 | .60114 | 0.04769 | +0.154 |
| .56086 | 0.94706 | +0.167 | .60714 | 0.05250 | +0.190 |
| .56986 | 0.95428 | +0.122 | .61314 | 0.05731 | +0.241 |
| .57706 | 0.96005 | +0.060 | .62214 | 0.06453 | +0.264 |
| .59206 | 0.97208 | 0.000 | .63474 | 0.07463 | +0.335 |
| .60106 | 0.97929 | -0.043 | .64134 | 0.07992 | +0.365 |
| 429.52192 | 0.56197 | +0.391 | .65154 | 0.08810 | +0.392 |
| .54052 | 0.57688 | +0.430 | .65754 | 0.09291 | +0.395 |
| .54892 | 0.58362 | +0.444 | .66594 | 0.09964 | +0.421 |
| .55732 | 0.59035 | +0.433 | .67194 | 0.10445 | +0.430 |
| .56872 | 0.59949 | +0.437 | .68064 | 0.11143 | +0.408 |
| .57712 | 0.60622 | +0.431 | .68694 | 0.11648 | +0.415 |
| .58912 | 0.61584 | +0.433 | .69534 | 0.12321 | +0.423 |
| .59782 | 0.62282 | +0.436 | .70134 | 0.12802 | +0.441 |
| .61132 | 0.63364 | +0.434 | .70804 | 0.13339 | +0.415 |
| .62272 | 0.64278 | +0.420 | 461.51561 | 0.21158 | +0.449 |
| .63112 | 0.64952 | +0.437 | .52341 | 0.21783 | +0.438 |
| .64372 | 0.65962 | +0.425 | .53181 | 0.22457 | +0.428 |
| .65212 | 0.66635 | +0.442 | .54441 | 0.23467 | +0.433 |
| .66052 | 0.67309 | +0.442 | .55281 | 0.24140 | +0.435 |
| .66892 | 0.67982 | +0.452 | .56181 | 0.24862 | +0.454 |
| .67792 | 0.68704 | +0.437 | .57021 | 0.25535 | +0.463 |
| .68812 | 0.69521 | +0.455 | .57861 | 0.26209 | +0.469 |
| .69652 | 0.70195 | +0.452 | .58701 | 0.26882 | +0.454 |
| .70492 | 0.70868 | +0.440 | .59601 | 0.27604 | +0.445 |
| .71392 | 0.71590 | +0.445 | .60441 | 0.28277 | +0.440 |
| .72232 | 0.72263 | +0.434 | .61341 | 0.28999 | +0.434 |
| .73072 | 0.72937 | +0.434 | .62421 | 0.29864 | +0.457 |
| 442.51784 | 0.98091 | -0.069 | .63411 | 0.30658 | +0.459 |
| .52794 | 0.98900 | -0.086 | .64251 | 0.31331 | +0.442 |
| .53484 | 0.99454 | -0.103 | .52664 | 0.23734 | +0.445 |
| .54174 | 0.00007 | -0.118 | .53424 | 0.24360 | +0.459 |
| .54714 | 0.00440 | -0.087 | .55044 | 0.25658 | +0.444 |
| .55374 | 0.00969 | -0.097 | .56004 | 0.26428 | +0.447 |

Table 4b / Continued

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 471.56934 | 0.27174 | +0.435 | 679.85520 | 0.25625 | +0.449 |
| .57864 | 0.27919 | +0.447 | .86120 | 0.26106 | +0.448 |
| .58824 | 0.28689 | +0.440 | .86720 | 0.26587 | +0.440 |
| .59604 | 0.29314 | +0.436 | .87410 | 0.27140 | +0.430 |
| .61194 | 0.30589 | +0.445 | .88280 | 0.27838 | +0.442 |
| .62124 | 0.31335 | +0.450 | .89120 | 0.28511 | +0.435 |
| 653.82443 | 0.38716 | +0.435 | .89720 | 0.28992 | +0.447 |
| .83043 | 0.39197 | +0.432 | 680.75632 | 0.97868 | -0.047 |
| .83643 | 0.39678 | +0.431 | .76472 | 0.98542 | -0.086 |
| .84783 | 0.40592 | +0.416 | .77312 | 0.99215 | -0.127 |
| .85503 | 0.41170 | +0.423 | .77912 | 0.99696 | -0.134 |
| .86163 | 0.41699 | +0.436 | .78512 | 0.00177 | -0.138 |
| 676.76593 | 0.77956 | +0.453 | .79112 | 0.00658 | -0.117 |
| .77133 | 0.78388 | +0.462 | .79712 | 0.01139 | -0.099 |
| .79953 | 0.80649 | +0.442 | .80672 | 0.01909 | -0.048 |
| .80973 | 0.81467 | +0.429 | .81332 | 0.02438 | -0.016 |
| .81573 | 0.81948 | +0.437 | .81872 | 0.02871 | +0.017 |
| .83193 | 0.83247 | +0.400 | .82592 | 0.03448 | +0.062 |
| .84363 | 0.84185 | +0.411 | .83192 | 0.03929 | +0.089 |
| 679.71180 | 0.14128 | +0.419 | .84032 | 0.04603 | +0.151 |
| .71780 | 0.14609 | +0.419 | .84752 | 0.05180 | +0.193 |
| .72620 | 0.15283 | +0.419 | .85352 | 0.05661 | +0.220 |
| .73220 | 0.15764 | +0.435 | .86612 | 0.06671 | +0.279 |
| .73820 | 0.16245 | +0.411 | 700.68947 | 0.95926 | +0.139 |
| .75380 | 0.17496 | +0.415 | .69547 | 0.96407 | +0.076 |
| .76040 | 0.18025 | +0.426 | .70147 | 0.96888 | +0.037 |
| .76640 | 0.18506 | +0.429 | .70987 | 0.97561 | -0.016 |
| .77480 | 0.19179 | +0.449 | .71587 | 0.98042 | -0.047 |
| .78140 | 0.19708 | +0.445 | .72187 | 0.98523 | -0.078 |
| .78740 | 0.20189 | +0.424 | .72787 | 0.99004 | -0.103 |
| .79580 | 0.20863 | +0.447 | .73387 | 0.99485 | -0.110 |
| .80180 | 0.21344 | +0.435 | .73987 | 0.99966 | -0.115 |
| .80840 | 0.21873 | +0.441 | .74737 | 0.00568 | -0.111 |
| .81680 | 0.22546 | +0.439 | .75367 | 0.01073 | -0.095 |
| .82340 | 0.23075 | +0.451 | .76207 | 0.01746 | -0.047 |
| .82940 | 0.23557 | +0.433 | .76867 | 0.02275 | -0.025 |
| .83540 | 0.24038 | +0.448 | .77527 | 0.02804 | +0.020 |
| .84260 | 0.24615 | +0.452 | .78127 | 0.03285 | +0.069 |
| .84860 | 0.25096 | +0.454 | .78727 | 0.03766 | +0.086 |

Table 4b Continued

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 700.79567 | 0.04440 | +0.175 | 701.82618 | 0.87057 | +0.418 |
| .80467 | 0.05161 | +0.194 | .83308 | 0.87610 | +0.408 |
| .81127 | 0.05691 | +0.261 | .83938 | 0.88115 | +0.406 |
| .81727 | 0.06172 | +0.255 | .84838 | 0.88837 | +0.413 |
| .82327 | 0.06653 | +0.272 | .85438 | 0.89318 | +0.408 |
| .82987 | 0.07182 | +0.320 | .86038 | 0.89799 | +0.387 |
| .83947 | 0.07951 | +0.356 | .86638 | 0.90280 | +0.393 |
| .84547 | 0.08432 | +0.369 | .87298 | 0.90809 | +0.389 |
| .85207 | 0.08962 | +0.357 | .87898 | 0.91290 | +0.364 |
| .85807 | 0.09443 | +0.393 | .88738 | 0.91963 | +0.334 |
| .86467 | 0.09972 | +0.398 | .89338 | 0.92444 | +0.324 |
| .87637 | 0.10910 | +0.383 | .89938 | 0.92925 | +0.296 |
| .88267 | 0.11415 | +0.387 | .90538 | 0.93406 | +0.269 |
| .89527 | 0.12425 | +0.421 | .91138 | 0.93887 | +0.251 |
| .90187 | 0.12954 | +0.408 | .92008 | 0.94585 | +0.186 |
| .90817 | 0.13459 | +0.424 | 703.67753 | 0.35481 | +0.446 |
| .91687 | 0.14157 | +0.409 | .68353 | 0.35962 | +0.434 |
| .92287 | 0.14638 | +0.408 | .69253 | 0.36684 | +0.448 |
| 701.67558 | 0.74983 | +0.467 | .69913 | 0.37213 | +0.442 |
| .68128 | 0.75440 | +0.451 | .70873 | 0.37982 | +0.444 |
| .68758 | 0.75945 | +0.441 | .71473 | 0.38463 | +0.437 |
| .69358 | 0.76426 | +0.441 | .72103 | 0.38968 | +0.435 |
| .70438 | 0.77292 | +0.459 | .73273 | 0.39906 | +0.432 |
| .71278 | 0.77965 | +0.439 | .73873 | 0.40387 | +0.413 |
| .71878 | 0.78446 | +0.434 | .74473 | 0.40868 | +0.408 |
| .72478 | 0.78927 | +0.436 | .75403 | 0.41614 | +0.409 |
| .73078 | 0.79408 | +0.441 | .75613 | 0.41782 | +0.418 |
| .73678 | 0.79889 | +0.417 | .76273 | 0.42312 | +0.402 |
| .74998 | 0.80948 | +0.433 | .76873 | 0.42793 | +0.425 |
| .75598 | 0.81429 | +0.415 | .77473 | 0.43274 | +0.420 |
| .76198 | 0.81910 | +0.429 | .78343 | 0.43971 | +0.391 |
| .76798 | 0.82391 | +0.412 | .79333 | 0.44765 | +0.412 |
| .77518 | 0.82968 | +0.441 | .79873 | 0.45198 | +0.377 |
| .78058 | 0.83401 | +0.436 | .80533 | 0.45727 | +0.388 |
| .79048 | 0.84195 | +0.419 | .81253 | 0.46304 | +0.369 |
| .79858 | 0.84844 | +0.415 | .82213 | 0.47074 | +0.382 |
| .80458 | 0.85325 | +0.398 | .82813 | 0.47555 | +0.368 |
| .81298 | 0.85998 | +0.412 | .83593 | 0.48180 | +0.346 |
| .82018 | 0.86576 | +0.398 | .85153 | 0.49431 | +0.365 |

Table 4b Continued

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 703.85813 | 0.49960 | +0.363 | 707.88971 | 0.73175 | +0.421 |
| .86653 | 0.50633 | +0.354 | .89571 | 0.73656 | +0.442 |
| .87253 | 0.51114 | +0.352 | .90171 | 0.74137 | +0.447 |
| .87853 | 0.51595 | +0.368 | .91011 | 0.74810 | +0.422 |
| .88573 | 0.52173 | +0.361 | 714.62640 | 0.13261 | +0.428 |
| .89473 | 0.52894 | +0.383 | .63480 | 0.13934 | +0.423 |
| .90103 | 0.53399 | +0.392 | .64380 | 0.14656 | +0.460 |
| .91153 | 0.54241 | +0.369 | .65460 | 0.15522 | +0.455 |
| 707.66351 | 0.55040 | +0.417 | .66300 | 0.16195 | +0.442 |
| .67011 | 0.55569 | +0.398 | .67140 | 0.16869 | +0.438 |
| .67611 | 0.56050 | +0.400 | .68040 | 0.17590 | +0.432 |
| .68451 | 0.56724 | +0.422 | .68940 | 0.18312 | +0.455 |
| .69111 | 0.57253 | +0.404 | .69900 | 0.19081 | +0.463 |
| .69781 | 0.57790 | +0.420 | .70740 | 0.19755 | +0.438 |
| .70731 | 0.58552 | +0.443 | .71610 | 0.20452 | +0.449 |
| .71391 | 0.59081 | +0.428 | 730.76143 | 0.06820 | +0.317 |
| .71991 | 0.59562 | +0.451 | .76743 | 0.07301 | +0.331 |
| .72891 | 0.60284 | +0.423 | .77403 | 0.07830 | +0.359 |
| .73491 | 0.60765 | +0.414 | .78303 | 0.08552 | +0.384 |
| .74451 | 0.61534 | +0.439 | .78903 | 0.09033 | +0.397 |
| .75051 | 0.62015 | +0.458 | .79503 | 0.09514 | +0.403 |
| .75711 | 0.62544 | +0.434 | .80403 | 0.10235 | +0.391 |
| .76401 | 0.63098 | +0.424 | .81033 | 0.10740 | +0.419 |
| .77691 | 0.64132 | +0.427 | .82443 | 0.11871 | +0.383 |
| .78291 | 0.64613 | +0.445 | .83103 | 0.12400 | +0.393 |
| .79011 | 0.65190 | +0.437 | .83703 | 0.12881 | +0.405 |
| .79791 | 0.65815 | +0.430 | .84303 | 0.13362 | +0.424 |
| .80691 | 0.66537 | +0.424 | 731.58676 | 0.72987 | +0.431 |
| .81351 | 0.67066 | +0.428 | .59276 | 0.73468 | +0.454 |
| .81951 | 0.67547 | +0.439 | .60416 | 0.74382 | +0.454 |
| .82551 | 0.68028 | +0.461 | .61196 | 0.75008 | +0.462 |
| .83091 | 0.68461 | +0.442 | .62096 | 0.75729 | +0.460 |
| .83691 | 0.68942 | +0.437 | .62726 | 0.76234 | +0.429 |
| .85011 | 0.70000 | +0.446 | .63476 | 0.76835 | +0.442 |
| .85611 | 0.70481 | +0.427 | .64316 | 0.77509 | +0.441 |
| .86211 | 0.70962 | +0.438 | .64916 | 0.77990 | +0.445 |
| .86871 | 0.71491 | +0.435 | .65516 | 0.78471 | +0.443 |
| .87471 | 0.71972 | +0.439 | .66746 | 0.79457 | +0.464 |
| .88071 | 0.72453 | +0.426 | .67736 | 0.80251 | +0.465 |

Table 4b Continued.

| JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ | JD Hel. 2438000+ | Phase | $\Delta m(c-v)$ |
|---------------------|---------|-----------------|---------------------|---------|-----------------|
| 731.68576 | 0.80924 | +0.432 | 761.76888 | 0.92713 | +0.295 |
| .69416 | 0.81598 | +0.430 | .77518 | 0.93218 | +0.256 |
| .70076 | 0.82127 | +0.428 | .78208 | 0.93771 | +0.217 |
| .70676 | 0.82608 | +0.442 | .78868 | 0.94300 | +0.192 |
| .71276 | 0.83089 | +0.435 | .79708 | 0.94974 | +0.143 |
| .72116 | 0.83762 | +0.409 | .80368 | 0.99503 | +0.092 |
| .72776 | 0.84291 | +0.406 | .80968 | 0.95984 | +0.080 |
| .73376 | 0.84772 | +0.417 | .81568 | 0.96465 | +0.034 |
| .73976 | 0.85253 | +0.419 | .82228 | 0.96994 | -0.004 |
| .74516 | 0.85686 | +0.412 | .82828 | 0.97475 | -0.018 |
| 736.71332 | 0.83988 | +0.423 | 767.49856 | 0.52066 | +0.377 |
| .71932 | 0.84469 | +0.430 | .50426 | 0.52523 | +0.381 |
| .73372 | 0.85623 | +0.404 | .51296 | 0.53221 | +0.396 |
| .74092 | 0.86201 | +0.395 | .51956 | 0.53750 | +0.386 |
| .74692 | 0.86682 | +0.397 | .52796 | 0.54423 | +0.392 |
| .75292 | 0.87163 | +0.404 | .53396 | 0.54904 | +0.397 |
| .77242 | 0.88726 | +0.410 | .54296 | 0.55626 | +0.395 |
| 761.68428 | 0.85931 | +0.404 | .54896 | 0.56107 | +0.420 |
| .69028 | 0.86412 | +0.392 | .55736 | 0.56780 | +0.422 |
| .69628 | 0.86893 | +0.389 | .56336 | 0.57261 | +0.422 |
| .71008 | 0.87999 | +0.390 | .57176 | 0.57935 | +0.434 |
| .71788 | 0.88624 | +0.394 | .57836 | 0.58464 | +0.443 |
| .72688 | 0.89346 | +0.392 | .58436 | 0.58945 | +0.444 |
| .73318 | 0.89851 | +0.393 | .60296 | 0.60436 | +0.440 |
| .74188 | 0.90548 | +0.361 | .60926 | 0.60941 | +0.446 |
| .74848 | 0.91078 | +0.361 | .61796 | 0.61639 | +0.444 |
| .75448 | 0.91559 | +0.346 | .62456 | 0.62168 | +0.445 |
| .76048 | 0.92040 | +0.334 | | | |

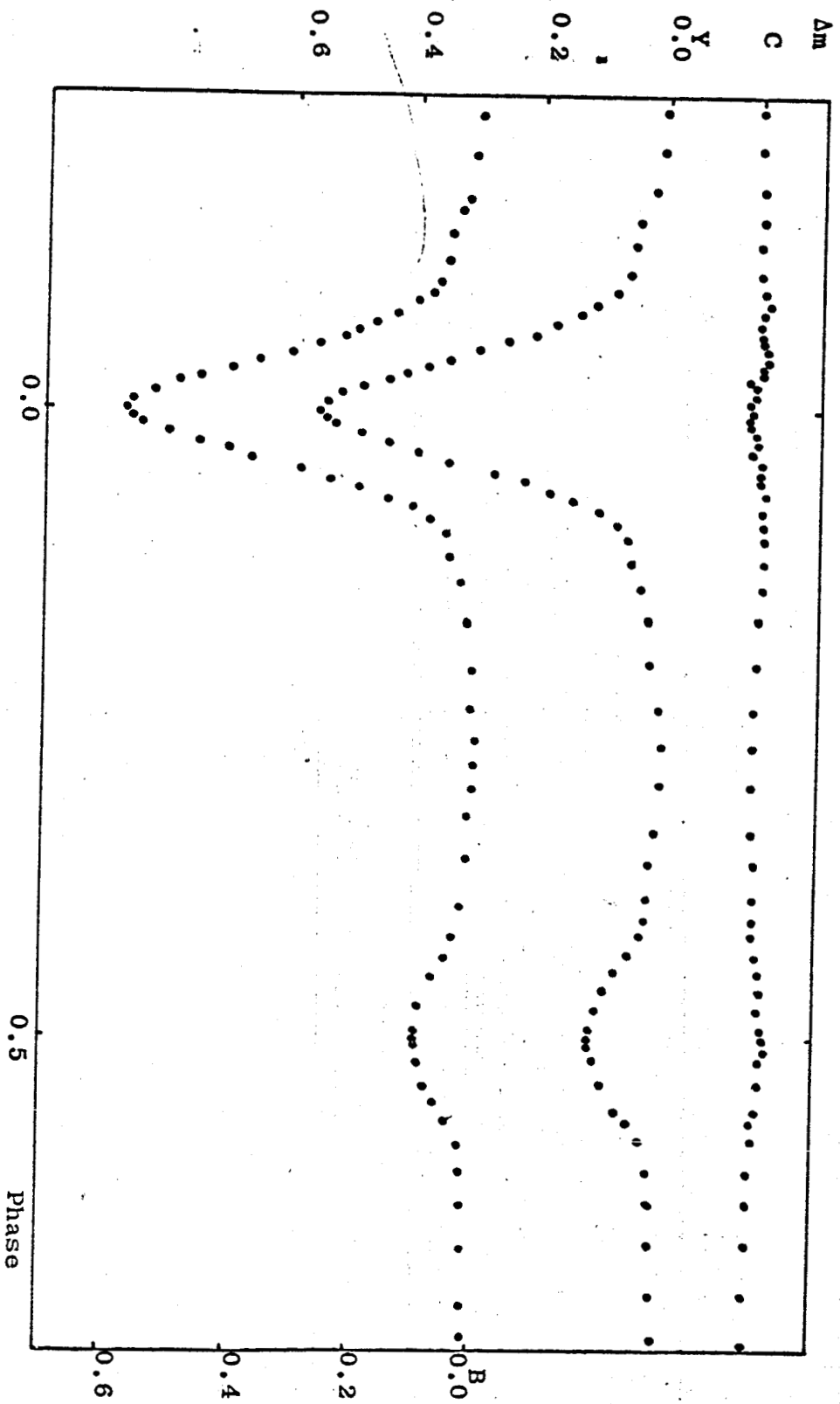


FIG. 1. BV 267 Normal Points and Color Curve.
Y = Yellow, B = Blue, C = Color.